D101.22:750-34

HERE'S YOUR

DA Pamphlet 750-34

1 MAY 1978

Preventive Maintenance of LEAD-ACID BATTERIES

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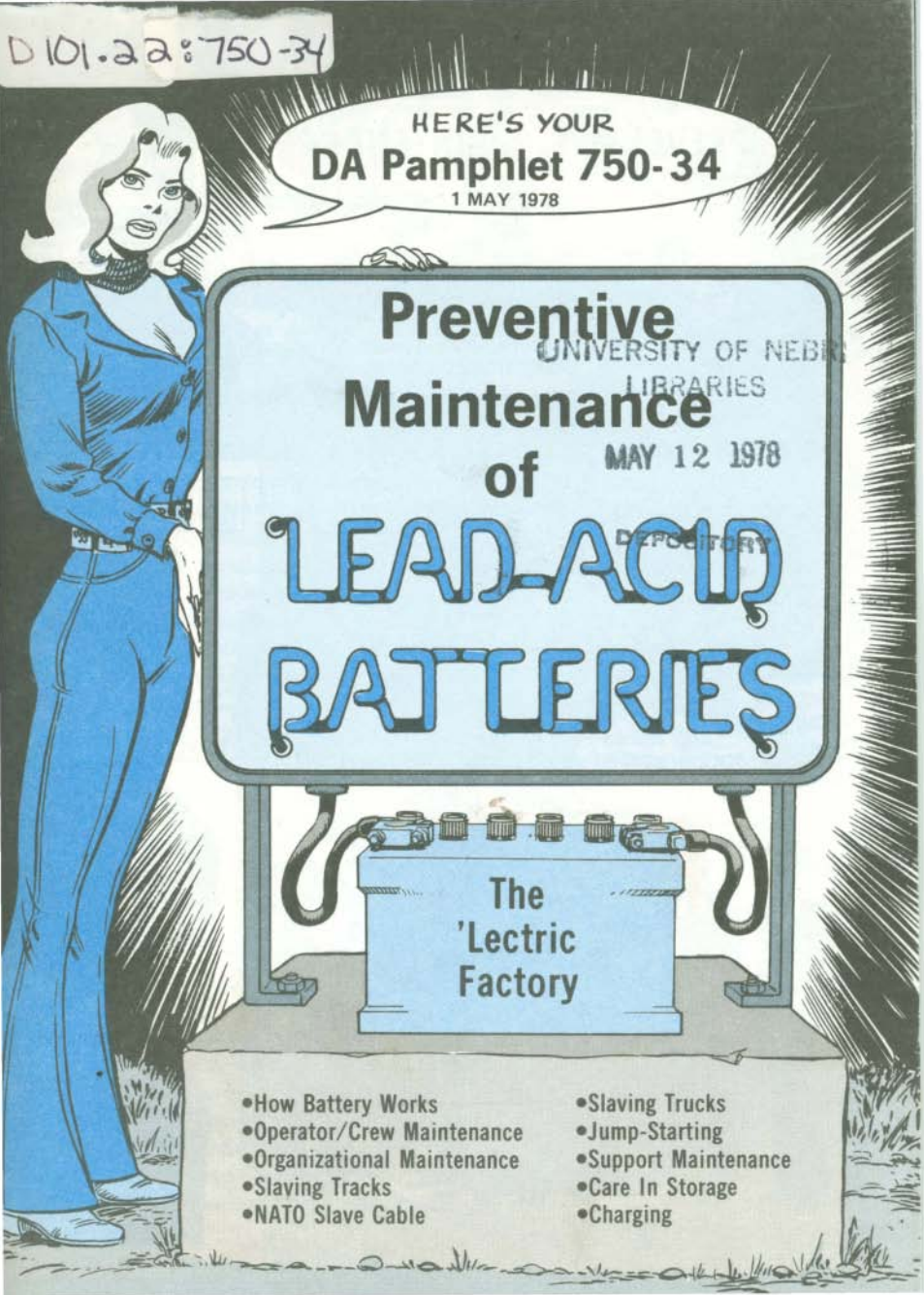
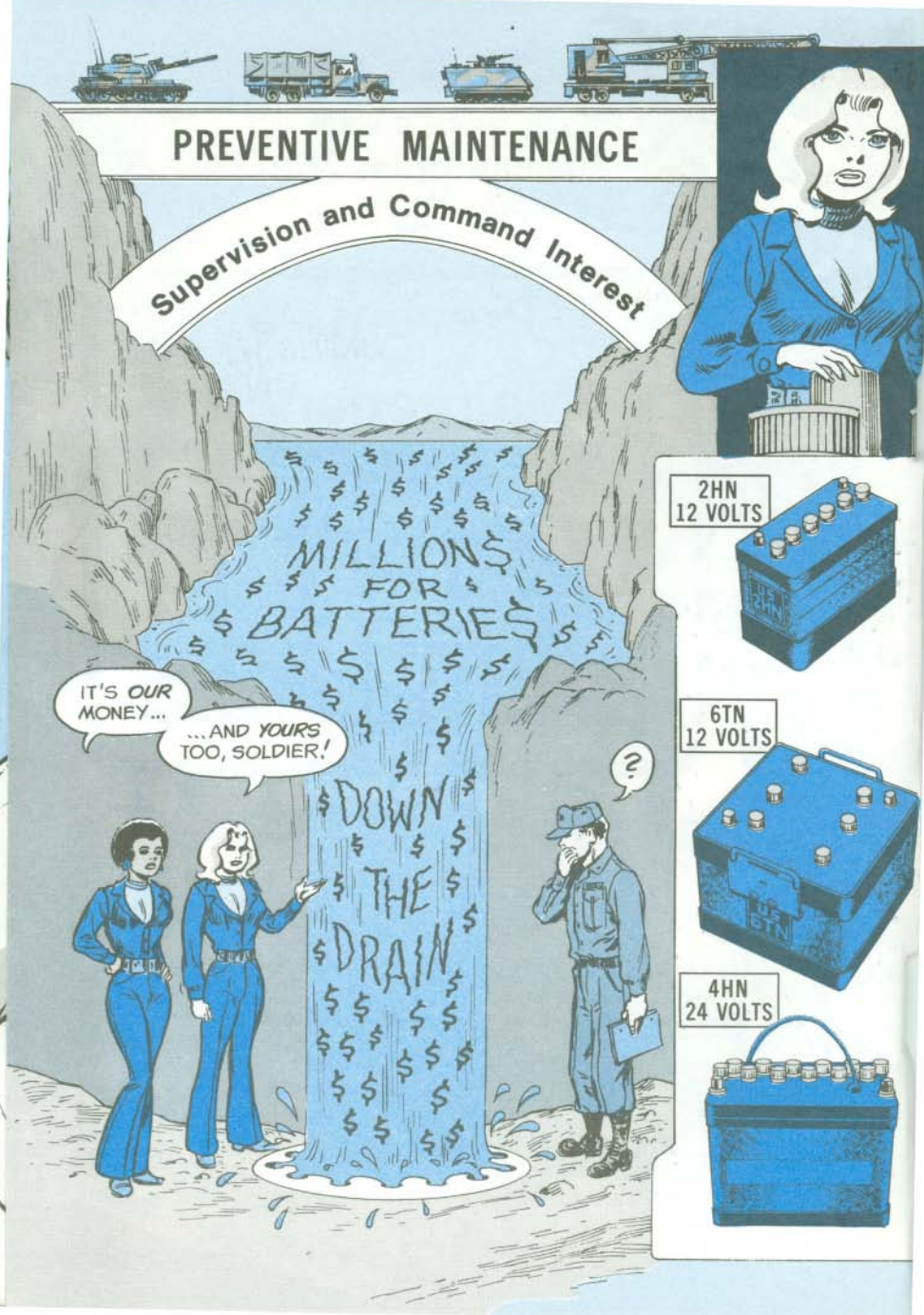
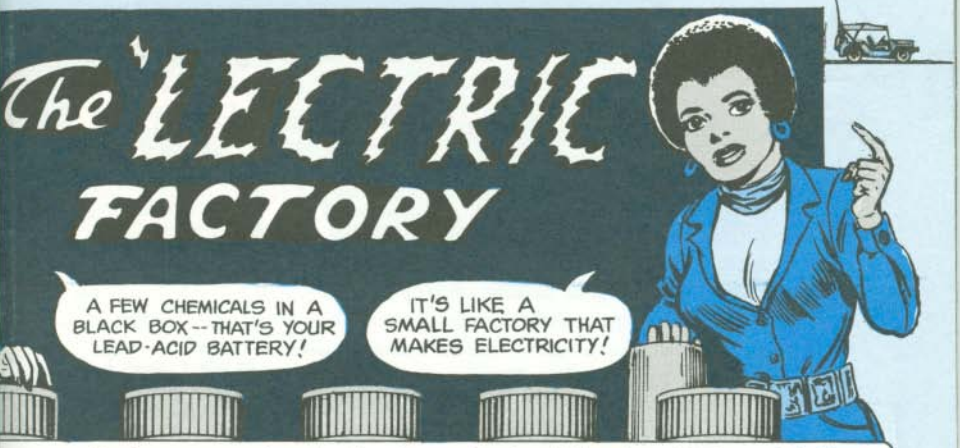
DEPOSITORY



- How Battery Works
- Operator/Crew Maintenance
- Organizational Maintenance
- Slaving Tracks
- NATO Slave Cable
- Slaving Trucks
- Jump-Starting
- Support Maintenance
- Care In Storage
- Charging


PREVENTIVE MAINTENANCE
Supervision and Command Interest
MILLIONS FOR BATTERIES
DOWN THE DRAIN
IT'S OUR MONEY...
...AND YOURS TOO, SOLDIER!
?
2HN
12 VOLTS
6TN
12 VOLTS
4HN
24 VOLTS


The 'LECTRIC FACTORY
A FEW CHEMICALS IN A BLACK BOX--THAT'S YOUR LEAD-ACID BATTERY!
IT'S LIKE A SMALL FACTORY THAT MAKES ELECTRICITY!

But it goes to work only when it gets the signal that electricity's needed, like when you use the starter motor to crank your engine. Or when you operate your radio while the engine's not running.

Then those chemicals go to work on each other. They change into different chemicals to "discharge" electricity.

This can keep going on until the chemical action fades out. Then the battery's "dead"—completely discharged. It can't supply any more electricity.

But your battery's got more lives than a cat. When the engine starts, the battery charging system kicks in. This is the voltage regulator and the alternator or generator. Charging turns the chemicals back like they were. The chemicals can start all over again. And the battery can keep on producing electricity.

This back-and-forth chemical action goes on until the battery is worn out. It can't be recharged any more.

How long will the battery last? It should be good for 3 or 4 years. Its life depends some on how much it's used.

But battery life depends more on the kind of Preventive Maintenance it gets—good PM or poor PM.

New batteries come to your Direct Support Unit "charged-and-dry." Your DSU puts in the electrolyte—a mix of water and sulfuric acid.

But the charge already in the battery is not enough. It's only about 70 percent of a full charge. So support gives the battery an "initial charge" to make it 100 percent ready-to-go.

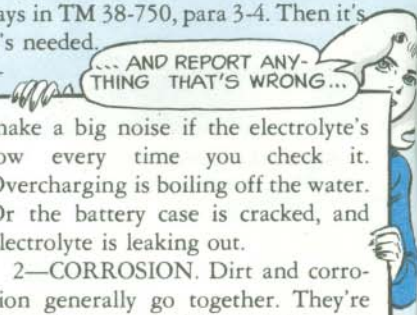
When the battery's installed in a truck, tank, tractor or whatever, it's ready to serve a long, useful life.

A battery doesn't ask for much. A drink of water once in awhile. A bath to keep it clean. A close watch on the charging system.

Your eyes, your fingers, a pencil and a DA Form 2404—those are the only tools you need to keep your battery putting out.

You report faults on the 2404, like it says in TM 38-750, para 3-4. Then it's up to your shop to take whatever action's needed.

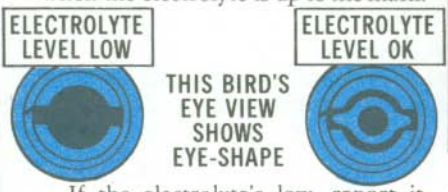
Once a week you make these checks—



1—BATTERY ELECTROLYTE. Unscrew the filler caps and look inside. Use a flashlight if it's dark down in there. Never use a match or other flame; the hydrogen gas in the battery can blow up.

The electrolyte level must be over the tops of the plates—about ⅜-inch over. Some batteries have a lip inside

to show where the electrolyte level should be. Or you can see an eye-shape when the electrolyte is up to the mark.



If the electrolyte's low, report it. Your mechanic will add distilled water to bring the level back up. You'd better make a big noise if the electrolyte's low every time you check it. Overcharging is boiling off the water. Or the battery case is cracked, and electrolyte is leaking out.

2—CORROSION. Dirt and corrosion generally go together. They're signs that somebody's not taking care of the battery. Corrosion eats away at metal parts. Dirt holds moisture. It lets electricity leak across the battery top—from one battery post to the other. This discharges the battery. It goes dead. This happens, too, when electricity leaks from the positive battery post to metal parts.

Corrosion is that white stuff caked on the battery posts and cable clamps—on any metal parts that touch the battery.

MAINTENANCE

If dirt and corrosion are not too bad, you can wipe it off with a clean cloth. But your mechanic will have to handle tough jobs.

3—CONNECTIONS. Make sure the clamps are tight on the battery posts. A loose clamp won't let the battery deliver full power. A common cause of engine starting failure is a loose clamp. Electricity can't get across from the battery post to the clamp.

Grab the clamp with your thumb and 2 fingers. Try to twist the clamp on the post. Look to see that the clamp is all the way down on the post.

Loose? Installed only part way? Report it.

And check the cable-to-clamp connections. With just your thumb and finger, lift and press the cable where it's bolted onto the clamp. Any movement? Get it tightened.

Check the other ends of the cables, too. Make sure you've got a tight connection where the ground cable hooks onto the engine or frame. And where the positive cable is connected to the starter relay.

Get loose connections tightened.

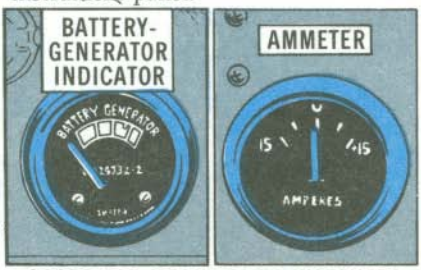
4—HOLDDOWNS. Batteries must be held snug—or they'll shift, rattle 'n' bounce and get broken. And connections will come loose.

Grab each battery and try to move it.

And if your batteries are carried in a pullout-type box, make sure the box can be fastened tight.

Holddowns loose? Get your mechanic on it.

5—PERFORMANCE. Your equipment has either a battery-generator indicator or an ammeter on the instrument panel.

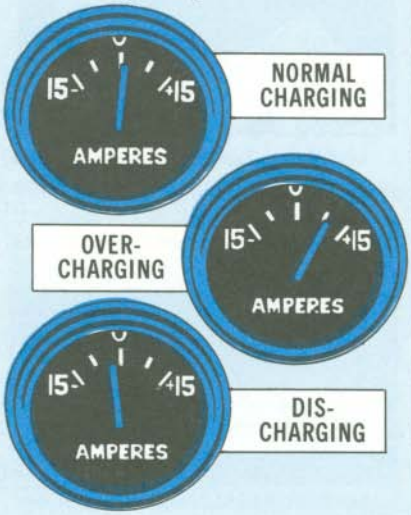


GAGES ARE MEANT TO BE WATCHED!

AMMETER

The ammeter tells you if your batteries are being charged or discharged. The ammeter will show a high charging rate right after you start the engine. The needle will hang to the right for several seconds—or maybe even for several minutes if your batteries had to put out a lot of electricity.

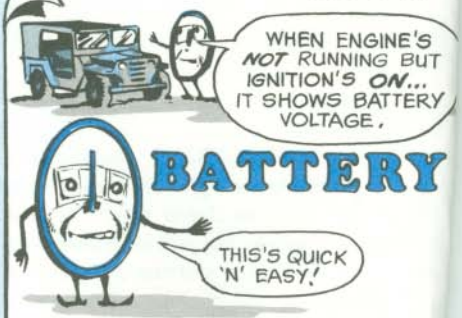
Then the ammeter needle will hold just a little to the right of center during normal engine operation.



If the needle stays to the far right, your batteries are being overcharged.

If the needle hangs to the left of center during engine operation, your batteries are being discharged. They'll go dead.

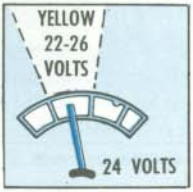
BAT-GEN

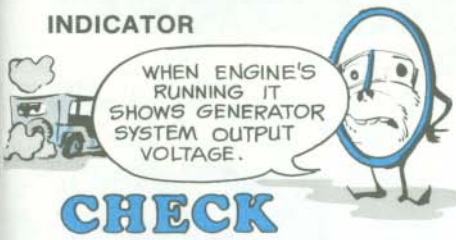


You find out much more about your batteries when you eyeball the BAT-GEN indicator.

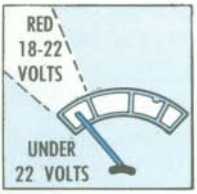
First, make sure all electrical units are OFF—heater, radio, lights, etc. Then turn the master switch ON. Or your equipment may have a battery switch or an ignition switch that triggers the indicator.

Look at the BAT-GEN indicator. If your batteries have a good charge, the needle should settle well into the yellow section—indicating about 24 volts.

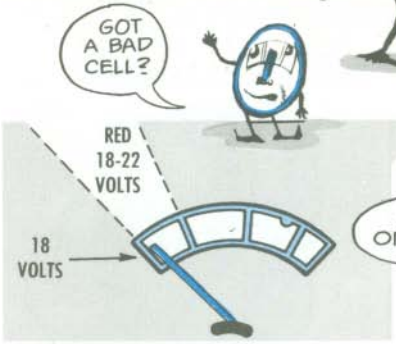




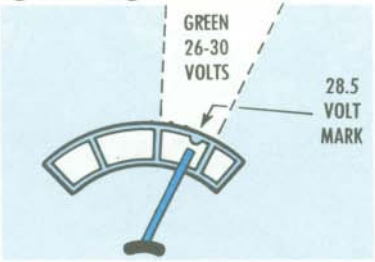
But if the needle hangs over in the left red section, you've got only 22 volts or less in your batteries. This means your batteries are weak, defective or need charging. Or there's a short in the system. Report it.



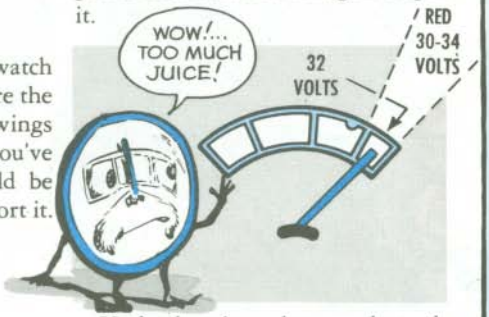
Now crank the engine and watch the needle. Get a good look before the engine starts. If the needle swings over into the left red section, you've got battery trouble. They could be worn out or have a bad cell. Report it.



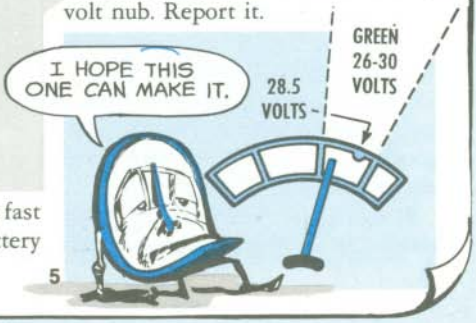
After the engine starts, run it at fast idle—about 1,500 RPM. Your battery charging system's working OK if the needle settles at about the 28.5-volt mark—that little white nub in the right of the green section.



Overcharging shows when the needle hangs in the right red section. Your batteries are being overcharged by a 30-to-34-volt charge. The water will boil out of your batteries. The plates inside can be damaged. Report it.



Undercharging shows when the needle settles well below that 28.5-volt nub. Report it.



Safety first means that you protect yourself from injury and your equipment from damage before you start working on the batteries.

Never wear rings or a wrist watch near the batteries. You can be badly

burned if such metal things touch a bare electrical connection.

Always take off the ground cable at the battery. This'll help protect the system from damage. It's also a good idea to wrap tape over the end of any cable you disconnect. Then it won't accidentally make contact with another cable or other metal.

If there's no reason for taking the clamp off the battery post, just take the cable off the clamp. Then you won't upset a good clamp-to-post connection.

TOOLS

These are part of your No. 1 Common Shop Equipment, listed in SC 4910-95-CL-A74 (Jul 77):

BATTERY FILLER, GRAVITY,

NSN 6140-00-635-3824

MAINTENANCE

ONLY *SUPPORT* DECIDES WHETHER A BATTERY IS UNSERVICEABLE!

RIGHT ON, CONNIE! MANY GOOD BATTERIES HAVE BEEN WINDING UP IN *PROPERTY DISPOSAL!*

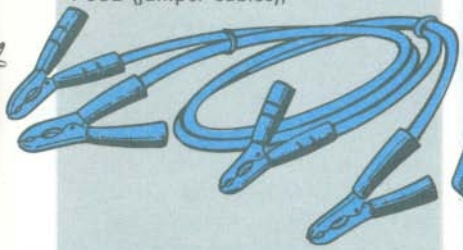
BATTERY FILLER, SYRINGE,

NSN 6140-00-643-4490

BRUSH, WIRE SCRATCH,

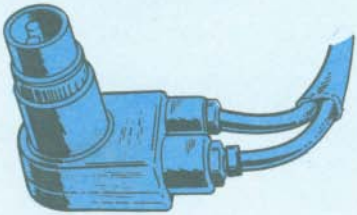
NSN 7920-00-291-5815

CABLE ASSEMBLY, SPECIAL PURPOSE (jumper cables),



NSN 2920-01-027-0125

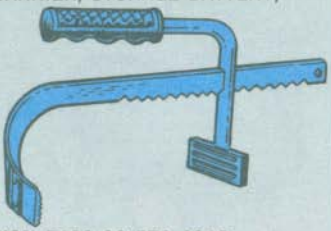
CABLE ASSEMBLY, SPECIAL PURPOSE (SLAVE CABLE),



NSN 2590-00-148-7961

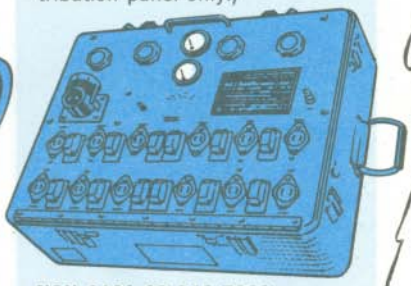
(See page 17 for details on NATO slave cable)

CARRIER, STORAGE BATTERY,



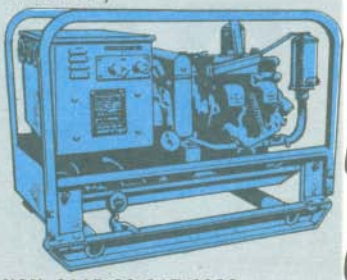
NSN 5120-00-570-4316

CHARGER, BATTERY, (This is distribution panel only.)



NSN 6130-00-940-7866.

(This panel is used with GENERATOR SET, 28-volt, authorized by your unit's TOE.)



NSN 6115-00-017-8239

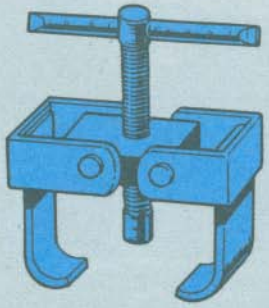
CLEANER, BATTERY TERMINAL,

NSN 6140-00-831-3449

GOGGLES, INDUSTRIAL,

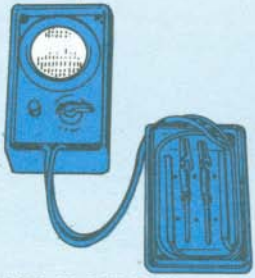
NSN 4240-00-269-7912

LIFTER, BATTERY TERMINAL,



NSN 5120-00-944-4268

MULTIMETER,



NSN 6625-00-999-6282

TESTER, ANTI-FREEZE AND BATTERY,

NSN 6630-00-105-1418

Wrenches for battery clamp and cable connections and for battery holddown hardware.

Your Self-Service Supply Center probably stocks these items (or order with CTA 50-970 as your authority):

DISTILLED WATER,

NSN 6810-00-356-4936 (5 gal)

RUBBER GLOVES,

NSN 8415-00-641-4601 (CTA-50-900)

RUBBER APRON,

NSN 8415-00-082-6108 (CTA 50-900)

BAKING SODA,

NSN 6810-00-264-6618 (1 lb)
NSN 6810-00-290-5574 (100 lb)

COATING COMPOUND,

NSN 8030-00-145-0151 (plastic)

NSN 8010-00-959-4661 (epoxy)

NSN 8030-00-290-5141 (bituminous)

PAINT BRUSH

SCRUB BRUSH (with natural or synthetic fiber bristles—**not** wire)

PUBLICATIONS

You also need a dab of Grease, Automotive and Artillery (always on hand in your shop), a soaking tub (made from steel drum) and plenty of clean water.

All battery setups should have rubber protector covers on the terminals. And the 2 main cables should be labeled POSITIVE and NEGATIVE.

Until they show up in your equipment's parts manual, you'll find them listed in TM 9-2320-218-20P (Jan 72) for the M151-series ¼-ton truck:

COVER, BATTERY TERMINAL LUG,

NSN 2920-00-738-6272

LABEL, BATTERY CABLE LEAD POSITIVE,

NSN 7690-00-477-3714

LABEL, BATTERY CABLE LEAD NEGATIVE,

NSN 7690-00-477-3715

TM 9-6140-200-14 (1978), Operator's, Organizational, Direct Support and General Support Maintenance Manual for Lead-Acid Storage Batteries.

The Organizational Maintenance Manual (-20 TM) for the equipment you're working on. Make sure it's up to date; check DA Pamphlet 310-4 (Oct 77).

DA Pamphlet 750-33 (Dec 76), Charging System Troubleshooting (The Easy Way).

TM 5-6130-301-12 (Oct 69). This gives you instructions for operating and maintaining your battery charging outfit.

TM 5-6116-271-14 (Aug 76) and the -24P (Oct 75) for the 3-KW generator used to power the battery charger.

See Page 30 for battery charging procedures.

But you won't be charging your own batteries anymore unless you're out in the field. The new -14 battery TM says only direct support unit will charge your batteries when you're in garrison.

EASY ON THE WATER

Many "dead" batteries are dead only because they've been drowned. Somebody used a bucket or a hose to add water to the electrolyte—and they flooded out the acid. With nothing but water in the battery, the battery can't be charged. It has to go back to Direct Support where it's checked for serviceability. Never dump out the electrolyte when you turn in a bum battery—DS wants it just like it is.

Even the gravity battery filler can get away from you when the battery needs only a little water. Use the syringe to add water to the battery. Use the gravity filler only to carry the water with you.

Never fill the battery all the way to the top of the fill holes. The electrolyte will "boil over" when the battery's being charged—and you'll lose some of the acid. Add just enough water to bring the electrolyte level to ⅜-inch over the tops of the plates inside.

And never add water if the battery's going to be sitting—not working—in a freezing temperature. The water'll freeze and bust the battery. It's OK to add water if the equipment's going to be operated right away. Charging will mix the new water with the electrolyte. The acid in the electrolyte lowers the freezing point.

Although distilled water's best for adding to the electrolyte, almost any water's better than letting the battery work with a low electrolyte level. Clean rain water's OK in a pinch. So is drinking water.

EASY ON YOURSELF

Nip corrosion in the bud—and save yourself a lot of work.

There should never be corrosion on a battery or on the metal parts around it. A close eyeballing and regular cleaning will prevent corrosion from starting.

Once corrosion starts, it can only get worse. It'll creep under the paint or other coating on metal parts. Then you've got to clean those parts down to bare metal and repaint or recoat.

If corrosion's allowed to chew too long on metal parts, you'll have to install new parts.

You can do the cleaning without removing the batteries from your equipment if you've kept dirt and corrosion from getting too bad. Just mix up some sodium bicarbonate (baking soda) in water—½-pound to a gallon of water. Use this and a scrub brush to clean all metal parts and the batteries. Keep the battery filler caps screwed in while you're scrubbing so you won't get the soda inside.

Then flush with clean water. If you find any bare metal on the holddowns, tray or box, wipe it dry and dab on some coating. (More on coating coming up.)

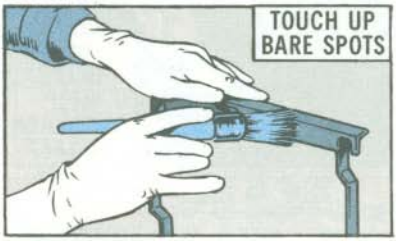
OR ALL THE WAY . . .

If you spot lots of corrosion, there's lots more you can't see. So you have to haul out the batteries and go over all of the metal parts—at least with your eyes.

Use your wire brush to clean off dirt, corrosion, rust and loose paint or

coating. Wear goggles to protect your eyes. Then scrub the parts in your wash tub with the baking soda and water mix. Let 'em soak awhile. Then rinse 'em in clean water.

After they've dried, touch up any bare metal with one of the 3 coatings available.



Use the same kind of coating that's already on the metal. If you want to switch to a different coating, you'll have to burn off the old stuff with a torch and use your wire brush to get down to clean, bare metal.

Wash the batteries, too. And clean the posts and clamps so they're bright

and shiny. Take off the filler caps and poke a wire into the vent holes to make sure they're clear. Screw the caps

back in just finger-tight. Wear rubber gloves—that electrolyte can burn you.

INSTALLING BATTERIES

Before you put your batteries back in the equipment, check to make sure they're matched. TM 9-6140-200-14, para 3-6, tells how.

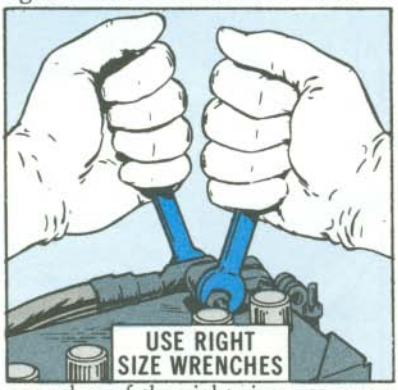
A strong battery will be damaged if it's teamed up with a weaker battery.

Always check for matching when you install a new or recharged battery.

Matching is important whenever you've got a set of 2 or more batteries in your equipment.

When you put the batteries in the equipment, tighten the holddowns only enough so you can't move the batteries around with your hands. Many batteries die young because holddowns are overtightened and crack the battery.

Make sure clamps are all the way down on the battery posts. Then tighten the bolt and nut with 2



wrenches of the right size—never an adjustable wrench. When the nut's snug, give it just a ¼-turn more. That's enough. Check the clamps by twisting with your thumb and 2 fingers.

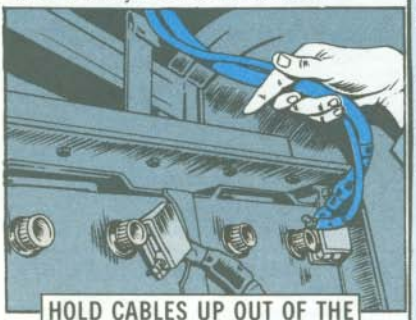
Mount the cable to the clamp with the cable terminal under the head of the bolt. Then it won't loosen up when the cable bounces. But if you've got 2 cables going to the same clamp, mount the second cable under the nut. You

can cut down on cable bounce by fastening the cable to the battery holddown with plastic hanger straps, NSN 5975-00-074-2072.

Tighten the cable-to-clamp bolt and nut enough but not too much. Use the right-size wrenches. Tighten snug and then a ¼- turn more. Test by pressing and lifting with your thumb and finger.

Then give the clamp and post a good coating of GAA—on top, all around and underneath. A thin coating—⅛ of an inch—is enough. This'll head off corrosion.

Be careful when you've got batteries in a drawer-type box. Make sure cables don't get pinched and cut behind the box when you slide it back in.



HOLD CABLES UP OUT OF THE WAY. PUSH THE BATTERY BOX BACK IN. THEN LAY THE CABLES ON THE LEDGE ON THE BACK OF THE BOX.

WHERE BATTERY CABLES ARE ROUTED THROUGH HOLES, MAKE SURE RUBBER GROMMETS ARE IN PLACE TO KEEP CABLE FROM GETTING CUT ON EDGE.

SAVE TIME, SWEAT 'N' MONEY

Troubleshoot battery charging problems by the book—DA Pamphlet 750-33—not by guessing. And use the -20 TM for your equipment, too, so you can locate the troubleshooting points.

You've heard of mechanics who spend time and money replacing parts—only to discover that the charging problem was caused by a dirty or loose wiring connection.

That's time and money wasted!

NEVER KICK A CRIPPLE

Jumping—or slaving—to get an engine started is a crutch. Good batteries will start an engine that's in good shape.

If the engine won't start with its own batteries, something's wrong—and should be fixed. Careful troubleshooting will nail down the fault.

Maybe the trouble is no more than a loose battery cable or other wiring connection.

Slaving with a slave cable or jump-starting with jumper cables can cause more trouble than you had to start with. Besides damaging the equipment, including the batteries, you can hurt yourself or somebody else.

But, when y'gotta go, y'gotta go—and slaving or jumping may be the only way.

Just make sure you do it right! To start with, get ahold of TB ORD 537 (Sep 56), Combat And Tactical Transport Vehicles: Procedure for Starting Engines with Slave Cable.

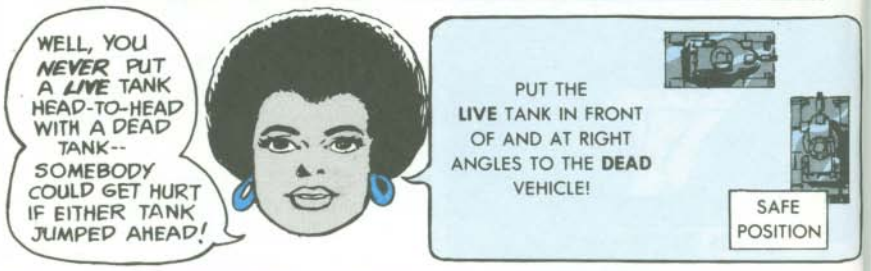
Organizational Maintenance

SLAVING TRACKS

TRACKED VEHICLE SLAVING CALLS FOR EVEN MORE CARE THAN SLAVING OTHER EQUIPMENT. EVERY YEAR, SOLDIERS ARE INJURED OR KILLED IN SLAVING ACCIDENTS.

Positions

WITH TANKS, THE EASIEST WAY IS TO HAVE THEM SIDE BY SIDE, FACING IN THE SAME DIRECTION...
SAFE POSITION
GREAT, BONNIE -- BUT WHAT DO YOU DO WHEN THE TANK YOU WANT IS SANDWICHED BETWEEN OTHER DEAD TANKS?


WELL, YOU NEVER PUT A LIVE TANK HEAD-TO-HEAD WITH A DEAD TANK-- SOMEBODY COULD GET HURT IF EITHER TANK JUMPED AHEAD!
PUT THE LIVE TANK IN FRONT OF AND AT RIGHT ANGLES TO THE DEAD VEHICLE!
SAFE POSITION

SAFE SLAVING MEANS THINKING THINGS OUT FIRST! STUDY THE SLAVING INFO IN YOUR TM BEFORE YOU START...
BE CAREFUL!
...AND ALWAYS HAVE A GROUND GUIDE HONCHO-ING THE OPERATION!
ONE PERSON KEEPING BOTH EYES ON THE WHOLE OPERATION CAN BE A LIFE SAVER!

Getting Ready

CARRY ON, CONNIE!

THERE ARE 3 THINGS THAT MUST BE DONE BEFORE ACTUAL CABLE HOOK UP...

(1) CHECK BATTERIES OF DEAD VEHICLE FOR DAMAGE . . . ELECTROLYTE LEVEL **OK?** CABLES, LEADS, GROUND STRAPS TIGHT AND FIRM?

(2) MAKE SURE BOTH VEHICLES ARE IN **P** (PARK) RANGE!

(3) MAKE SURE PARKING BRAKES ARE SET, AND THAT THE MASTER SWITCH AND ALL ELECTRICAL AND ELECTRONIC EQUIPMENT SWITCHES IN BOTH VEHICLES ARE **OFF!**

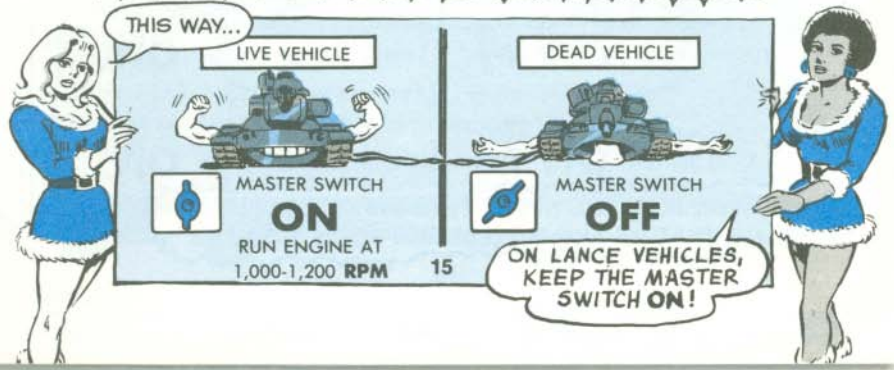
CAUTION: BE SURE THAT ALL ELECTRICAL AND ELECTRONIC SWITCHES ARE OFF

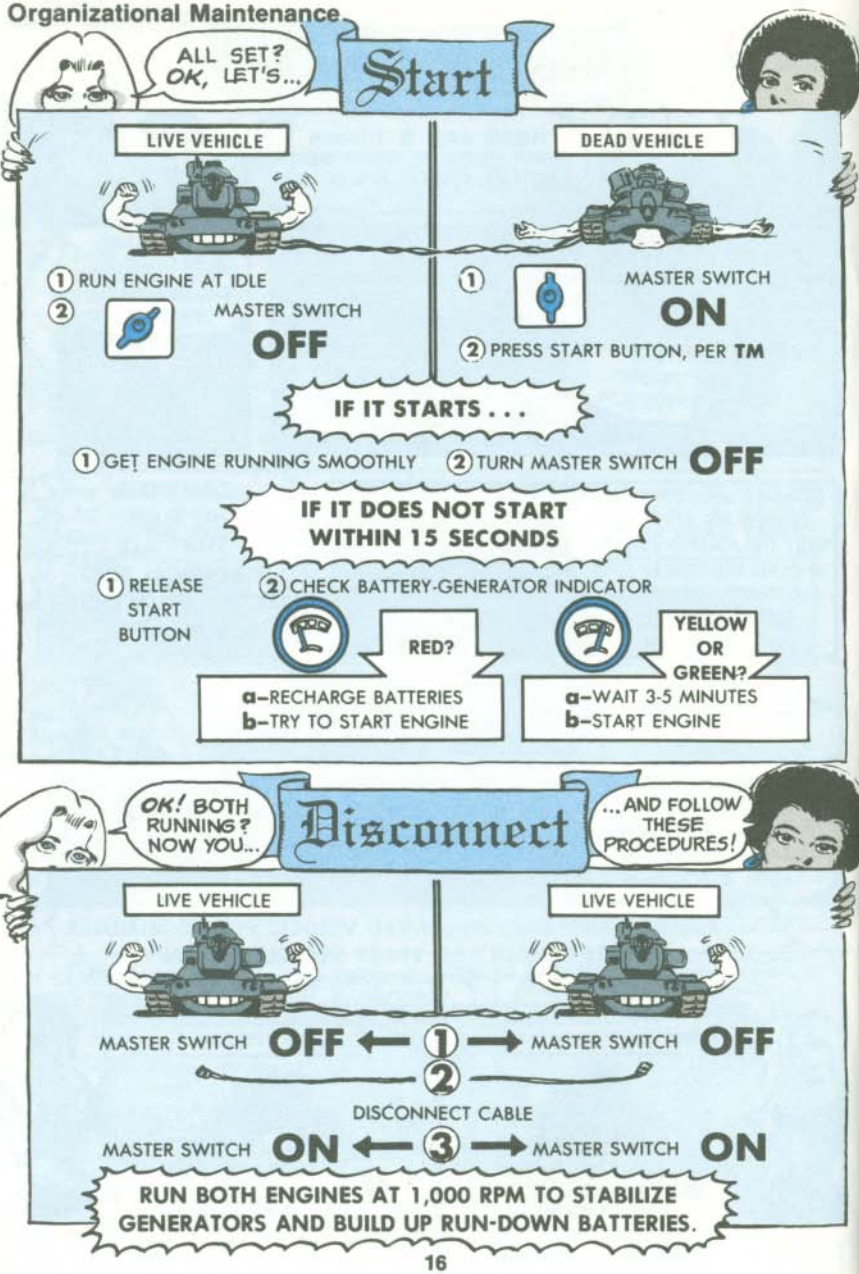
Hook Up

WITH MASTER SWITCHES IN **BOTH** VEHICLES **OFF**, ATTACH SLAVE CABLE SECURELY IN BOTH. IF YOU HAVE TIME . . .

CHARGE BATTERIES IN SLAVED VEHICLE FOR 15 MINUTES BEFORE YOU TRY TO START VEHICLE AGAIN.

THIS WAY...




ALL SET? OK, LET'S...
Start
LIVE VEHICLE
DEAD VEHICLE
1 RUN ENGINE AT IDLE
2 MASTER SWITCH OFF
1 MASTER SWITCH ON
2 PRESS START BUTTON, PER TM
IF IT STARTS . . .
1 GET ENGINE RUNNING SMOOTHLY
2 TURN MASTER SWITCH OFF
IF IT DOES NOT START WITHIN 15 SECONDS
1 RELEASE START BUTTON
2 CHECK BATTERY-GENERATOR INDICATOR
RED?
a–RECHARGE BATTERIES
b–TRY TO START ENGINE
YELLOW OR GREEN?
a–WAIT 3-5 MINUTES
b–START ENGINE
OK! BOTH RUNNING? NOW YOU...
Disconnect
...AND FOLLOW THESE PROCEDURES!
LIVE VEHICLE
LIVE VEHICLE
MASTER SWITCH OFF ← 1 → MASTER SWITCH OFF
2
DISCONNECT CABLE
MASTER SWITCH ON ← 3 → MASTER SWITCH ON
RUN BOTH ENGINES AT 1,000 RPM TO STABILIZE GENERATORS AND BUILD UP RUN-DOWN BATTERIES.

NATO SLAVE CABLE NEWS

So now you've got the M60A1 (RISE) tank. How do you slave it?

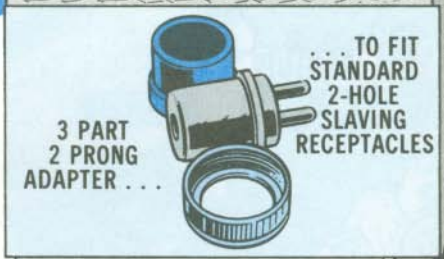
No way you can do it without the new NATO slave cable NSN 2590-00-148-7961. This cable has a single prong at each end to fit the NATO slaving receptacle. It also comes with a 3-part 2-prong adapter at both ends to fit the standard 2-hole slaving receptacles.

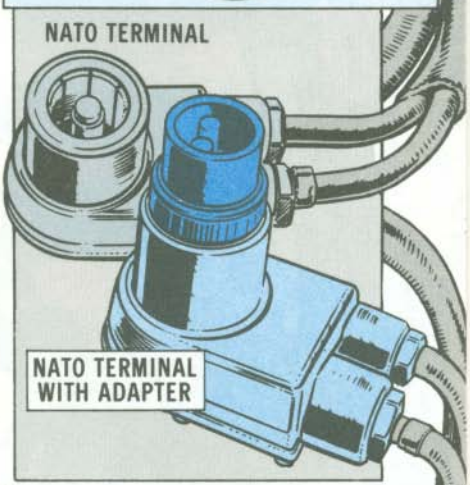
As you can see, the NATO cable can do it all . . . slave 2 NATO vehicles, 1 NATO and 1 non-NATO or a pair of non-NATO vehicles.

It's so handy it'll replace the old 2-prong slave cable NSN 4910-00-474-9135 in the No. 1 and No. 2 common tool kits.

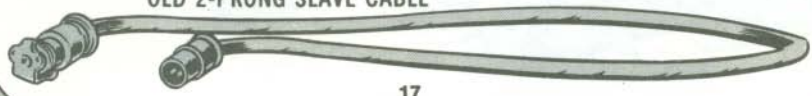
In time the 2-prong receptacles will be phased out and all new vehicles, both wheeled and track, will have NATO receptacles.

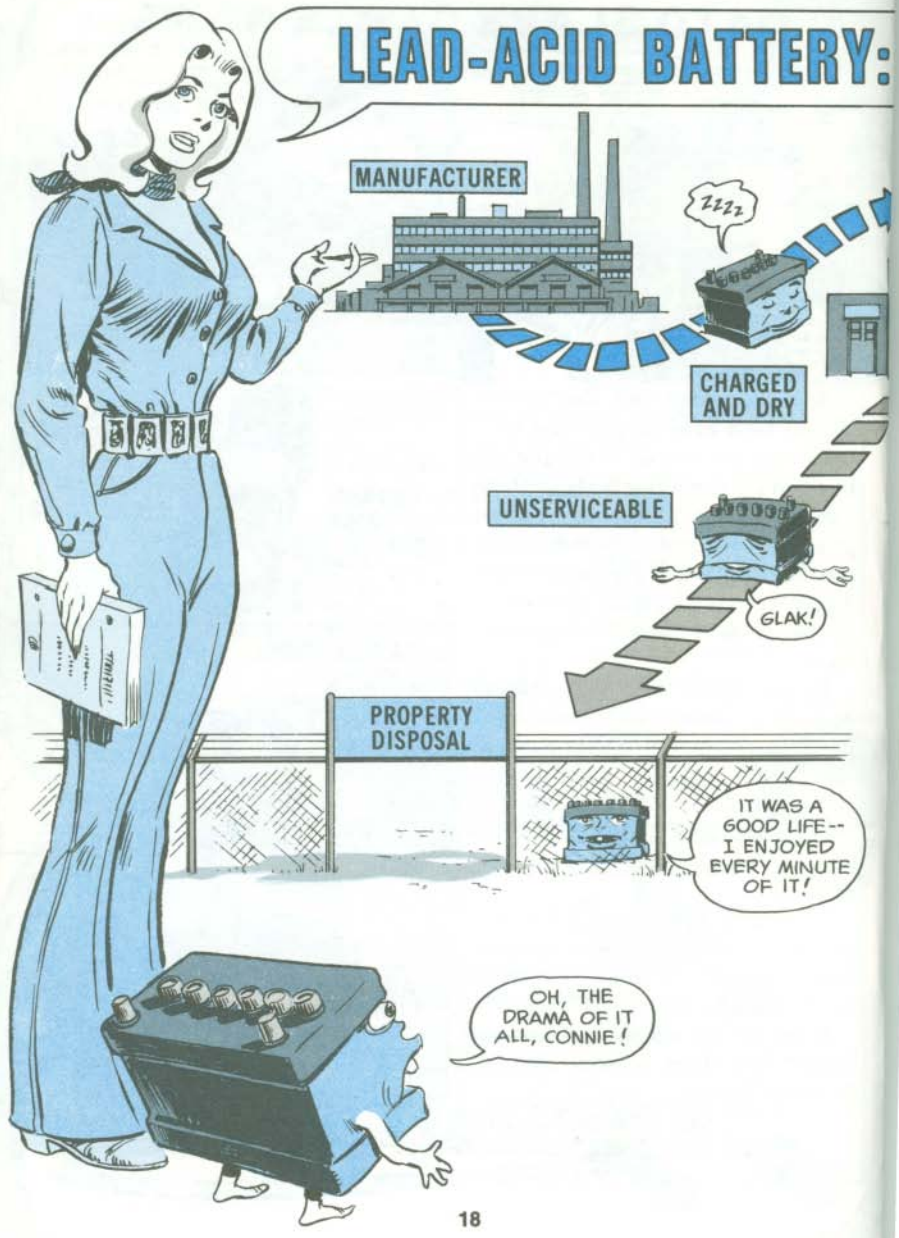
If the NATO adapters get lost, the AMDF lists them as NSN 5935-00-322-8959 per set.



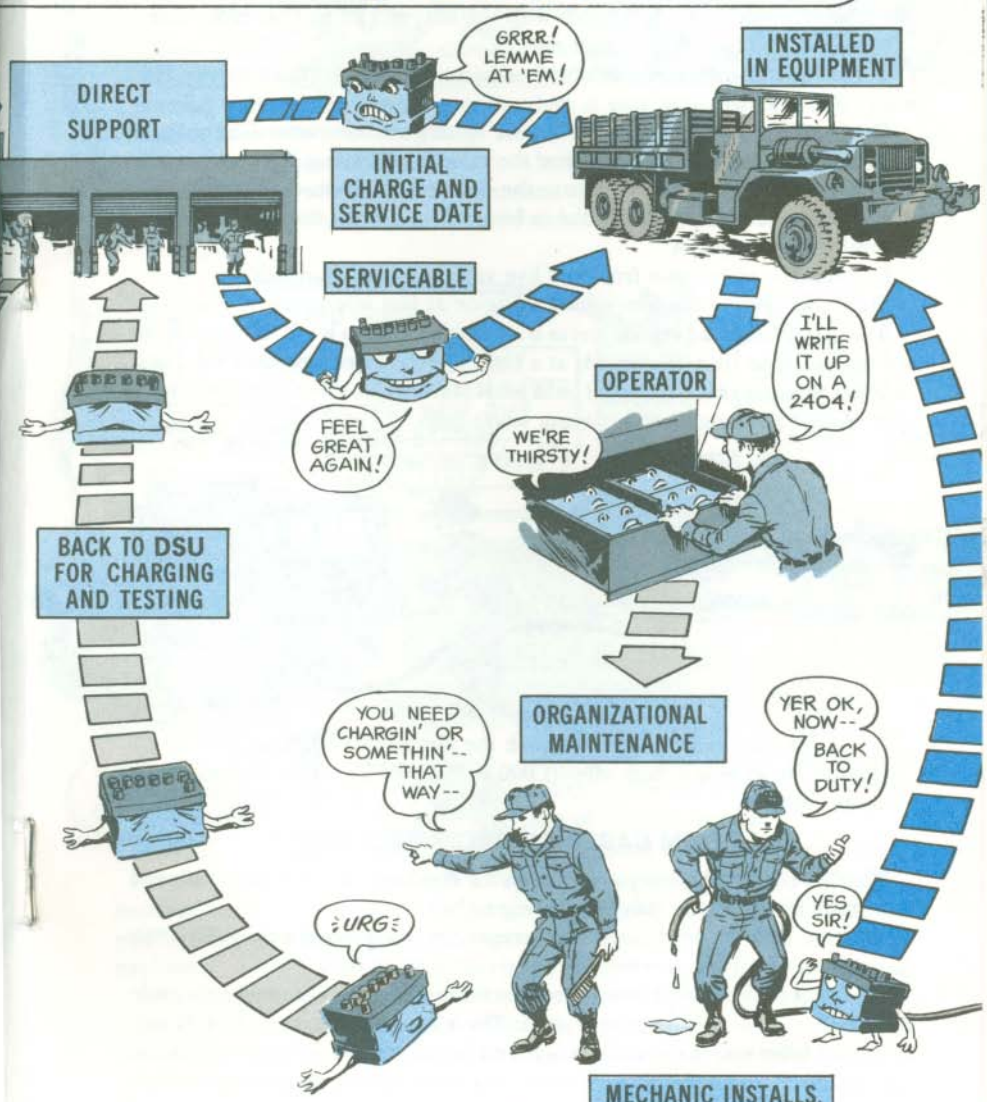


OLD 2-PRONG SLAVE CABLE




LEAD-ACID BATTERY:
MANUFACTURER
ZZZZ
CHARGED AND DRY
UNSERVICEABLE
GLAK!
PROPERTY DISPOSAL
IT WAS A GOOD LIFE-- I ENJOYED EVERY MINUTE OF IT!
OH, THE DRAMA OF IT ALL, CONNIE!

THIS IS YOUR LIFE!



SLAVING MILITARY-DESIGN TRUCKS

You slave-start a military-design truck that's got a slave receptacle much like you do a tank. Most such trucks still have the 2-hole receptacle, but you can use the new NATO-design slave cable with the adapters to fit that receptacle.

Slave-starting is easy, but do it right:

Check the electrolyte level in your dead battery—all cells in all batteries. Add water if it's needed.

Doublecheck all electrical cable and wiring connections. Cleaning or tightening a hookup might save you the trouble of slaving.

Try to position the live vehicle so the slave cable will reach directly to the dead vehicle. Set the parking brake in both vehicles. Shift the transmission to neutral in both vehicles.

Connect the slave cable from the live vehicle to the dead vehicle.

Start and operate the live vehicle's engine at fast idle speed.

Try to start the dead vehicle just as if its starting system is OK. Never run the starter for more than 30 seconds at a time. Let the starter cool off for 2 or 3 minutes between tries—or you'll burn it up. If the engine won't start in 3 tries, quit. You've got trouble that slaving won't help.

If you get the engine started, unhook the slave cable right away.

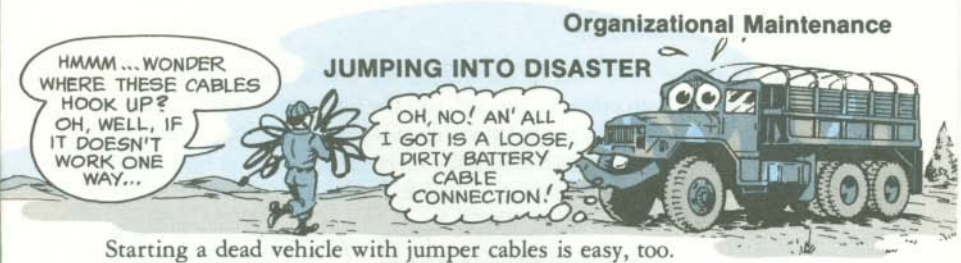
Operate the engine at high idle—1,000 to 1,500 RPM—until you're sure it's running smooth.

BUM CABLE OR RECEPTACLE?

That TB ORD 537 gives you some tips for checking out your slave cable and receptacle to make sure they're working right.

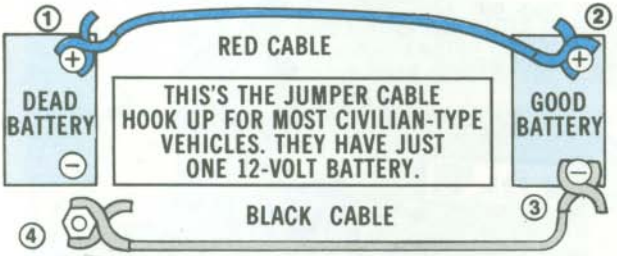
There've been cases of cables and receptacles being wired wrong. This can damage your equipment when you're trying to slave start.

The biggest killer of cables and receptacles is the guy who unhooks the cable during the engine cranking operation. The electrical load is terrific. It arcs across the cable and receptacle contacts and burns 'em out. So keep your knees, elbows and big feet away from the slave cable while the engine is being cranked.


JUMPING INTO DISASTER
HMMM ... WONDER WHERE THESE CABLES HOOK UP? OH, WELL, IF IT DOESN'T WORK ONE WAY...
OH, NO! AN' ALL I GOT IS A LOOSE, DIRTY BATTERY CABLE CONNECTION!

Starting a dead vehicle with jumper cables is easy, too.

But it's easier to screw up things with jumper cables. The cables can be hooked up wrong just as easy as they can be hooked up right. You could blow the diodes in an alternator. Worse, you could blow up the battery—an explosion that can shower you with acid and send pieces of the battery flying like shrapnel.



WHEN YOU GET THE ENGINE STARTED, UNHOOK THE CABLES IN REVERSE ORDER—4, 3, 2, 1.

THIS CONNECTION IS ON THE ENGINE, ANY PLACE THAT'S A FOOT OR SO FROM THE BATTERY. IF THE BATTERY'S NOT IN THE ENGINE COMPARTMENT, HOOK UP TO THE FRAME OR SOME UNPAINTED PART OF THE BODY.

Clip one end of the red cable to the positive (+) post of the dead battery and the other end to the positive (+) post of the live battery.

The black cable is connected last.

You clip one end of the black cable to the negative (-) post of the live battery—but you don't connect the other end to the dead battery at all. If you do, you'll probably strike a spark—and that spark could cause the dead battery to explode.

So, instead, you clip the cable to the engine or frame of the dead vehicle—any place that's far enough from the dead battery to keep a spark from blowing up the battery. You may have to clean the dirt, grease or paint from your hookup-point to get a good connection.

Careful! Keep the cables out of the engine fan and drive belts.

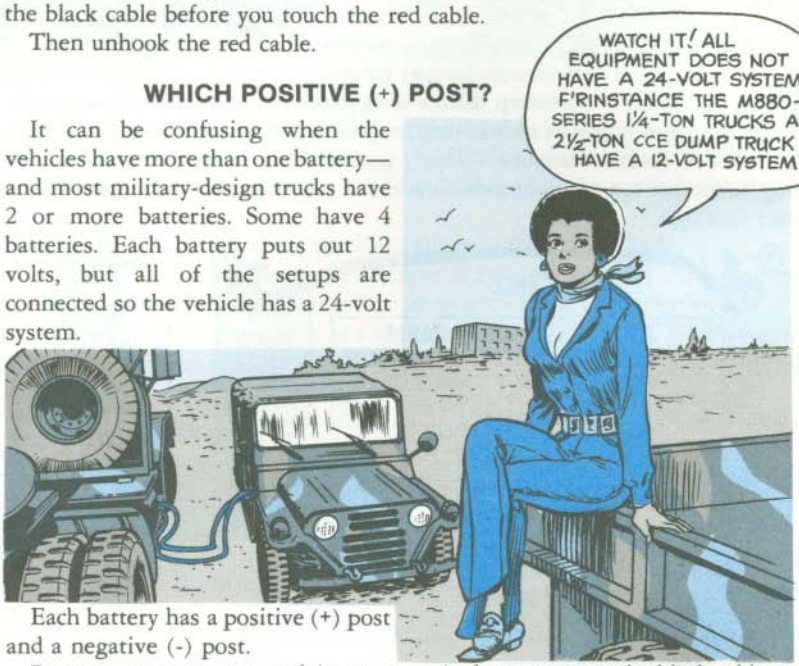
When you've got both cables connected, run the live vehicle's engine and try to start the dead vehicle the same as you do when a slave cable is used.

As soon as the engine starts, unhook the black cable. Unhook both ends of the black cable before you touch the red cable.

Then unhook the red cable.

WHICH POSITIVE (+) POST?

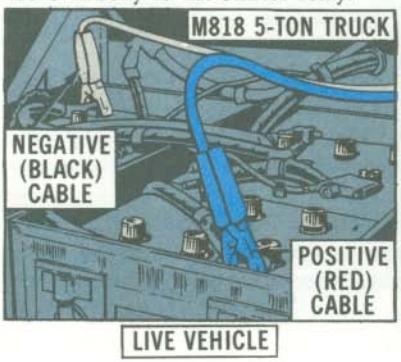
It can be confusing when the vehicles have more than one battery—and most military-design trucks have 2 or more batteries. Some have 4 batteries. Each battery puts out 12 volts, but all of the setups are connected so the vehicle has a 24-volt system.

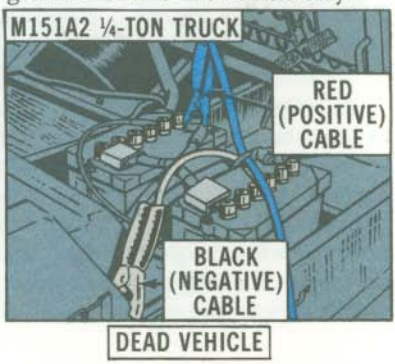

WATCH IT! ALL EQUIPMENT DOES NOT HAVE A 24-VOLT SYSTEM. F'RINSTANCE THE M880-SERIES 1¼-TON TRUCKS AND 2½-TON CCE DUMP TRUCK HAVE A 12-VOLT SYSTEM.

Each battery has a positive (+) post and a negative (-) post.

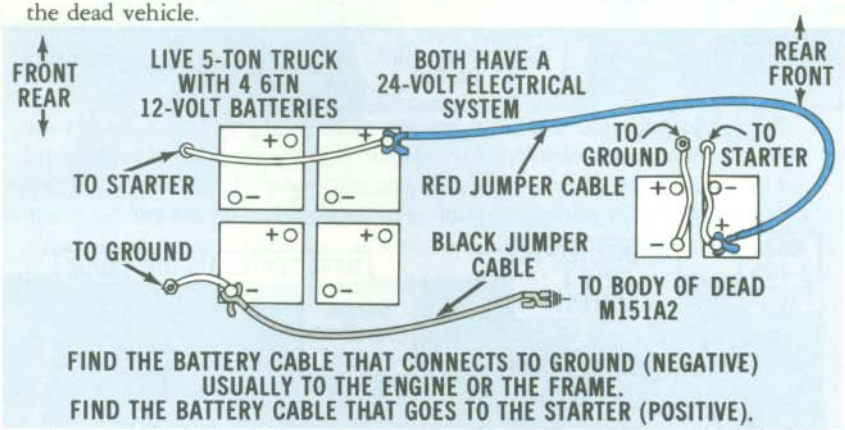
But you connect your red jumper cable only to the positive post that feeds directly to the starter relay.

And you connect the black cable to the negative post that feeds directly to ground—on the live vehicle only.





This matches the 24-volt system of the live vehicle to the 24-volt system in the dead vehicle.



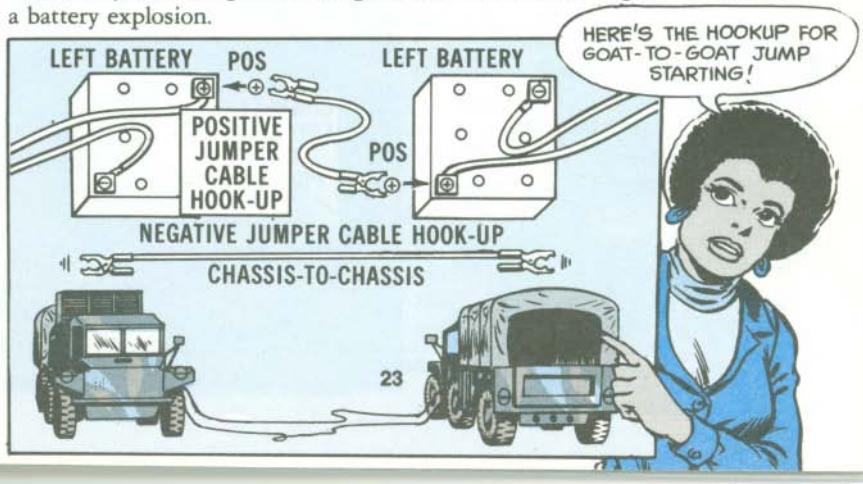
Even trickier is the 2-battery setup on the Gama Goat—M561 and M792 1¼-ton vehicles. You can't make a 24-volt connection on the right side of the Gama Goat—it's only 12-volts.

You have to connect your red jumper cable to the positive post of the left-side battery. If you're jump-starting a Gama Goat with another Goat, it's best to park the vehicles with the left sides toward each other. The Goats will be facing in opposite directions.

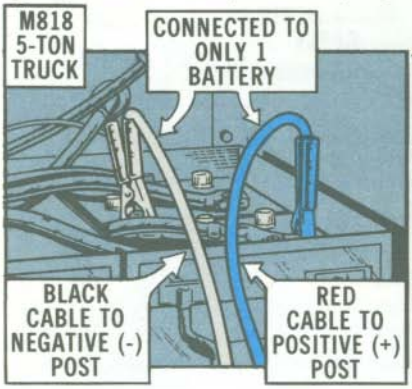
Connect your red jumper cable from the positive post of one Goat's left-side battery to the positive post of the other Goat's left-side battery.

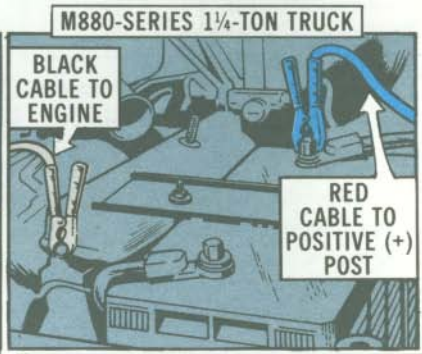
The black cable should not be connected to the batteries. Instead, you hook up to the vehicle body—on both vehicles. You may have to scratch through the body paint with the cable clips to get a good chassis ground.

Be sure your hookup is far enough from the batteries so a spark won't set off a battery explosion.



You can jump-start a 12-volt system—like in the M880-series 1¼-ton vehicles—from a vehicle with a 24-volt system. But you jump from only one of the batteries in the 24-volt vehicle. Repeat—only one of the batteries. This'll give you the 12 volts you need to jump-start the dead 12-volt system.



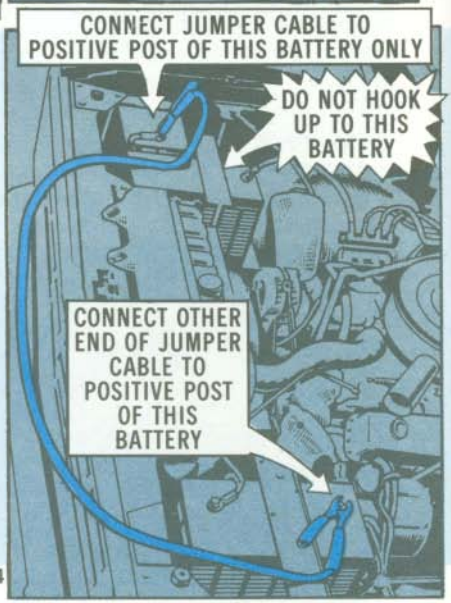


If you've got an M880-series truck with the add-on 60-amp or 100-amp system, you can jump start from one of those 2 batteries.

You don't even need to use the black jumper cable. That pair of batteries has the same ground as the single battery that powers the starter.

Careful, though! Hook up only to the battery at far right. This'll give you 12 volts. If you hook up to that battery's mate, you'll get 24 volts—and damage the 12 volt electrical system.

Just connect the red cable from the positive post on the far right battery to the positive post on the far left battery. Then try to start the engine.


CONNECT JUMPER CABLE TO POSITIVE POST OF THIS BATTERY ONLY
DO NOT HOOK UP TO THIS BATTERY
CONNECT OTHER END OF JUMPER CABLE TO POSITIVE POST OF THIS BATTERY

FOR BATTERY'S SAKE...

USE RIGHT TOOL!

You wouldn't use a hammer to cut a board, would you? Heck no — that's just plain dumb!

Well, even worse is using a crescent wrench, screw driver or some other such thing to pry the clamp off a battery post. You stand a good chance of busting a hole in the top of your battery. Then that battery is shot! Done for! Junk!

There's a special tool for this job: Lifter, battery terminal, NSN 5120-00-944-4268 — in your No. 1 Common Tool Kit.

Use it!

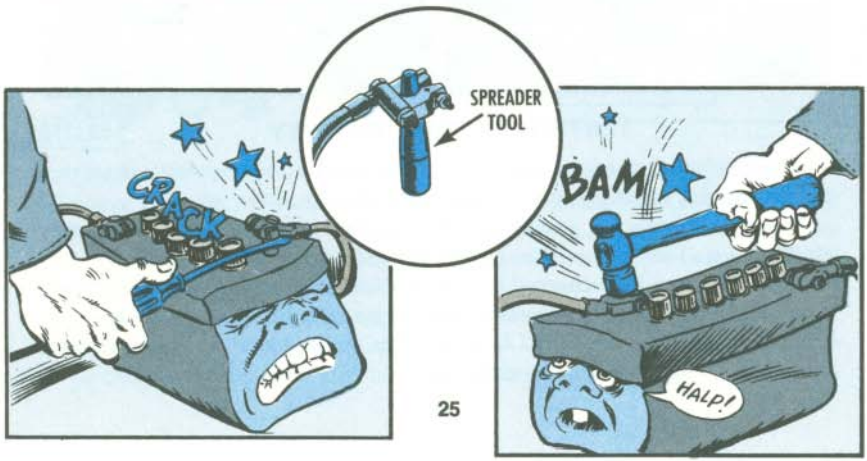
And never use that big ol' crescent wrench for loosening the battery clamp bolt. It can slip off and knock a hole in your battery top quicker'n you can spit.

Always use an open-end or box wrench of just the right size.

No pounding when you're puttin' the clamp back on the post. You'll drive the post right down into the battery — and really mess things up inside.

The clamp should drop right down over the post with no sweat. If it won't, open it up so it will.

A handy clamp-spreader can be made from 1-in dia bar stock. Your support can turn this tapered tool on a lathe in a coupla minutes.

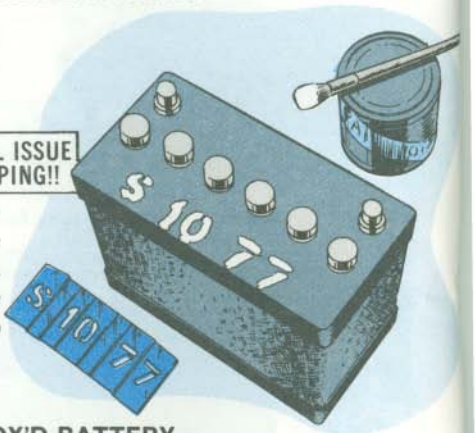


CHARGING NEW BATTERIES

A new charged-and dry battery is made ready for issue by your putting in the electrolyte and giving the battery its initial charge.

PAINT OR STENCIL ISSUE DATE—NO STAMPING!!

And you issue the battery with the service date already painted on the top. This's done free-hand with a brush or can be stencilled on the battery. Using a stamp and hammer to apply the service date is out—taboo.



CHECKING DX'D BATTERY

You've got to check out a battery thát's turned in as no-good to see if it's really "unserviceable." If the battery can't be repaired or can't be fully recharged or can't stand up to a load test, it's unserviceable and goes to Property Disposal.

The only repair you're authorized is fixing cracks in the case and rebuilding the posts. These repairs are covered by para 4-10 and 4-11 in TM 9-6140-200-14.

TESTING SPECIFIC GRAVITY

After you've repaired the battery—or if it needs no repair—your first step is checking the specific gravity of the electrolyte.

Testing the specific gravity of the electrolyte shows how strong the electrolyte is. This's covered in para 3-10, TM 9-6140-200-14.

Electrolyte in a fully-charged battery is about 75 percent water and 25 per cent sulfuric acid. As the battery discharges, chemical action makes the electrolyte weaker—less acid. Charging turns the chemical action around, so the electrolyte gets stronger—more acid.

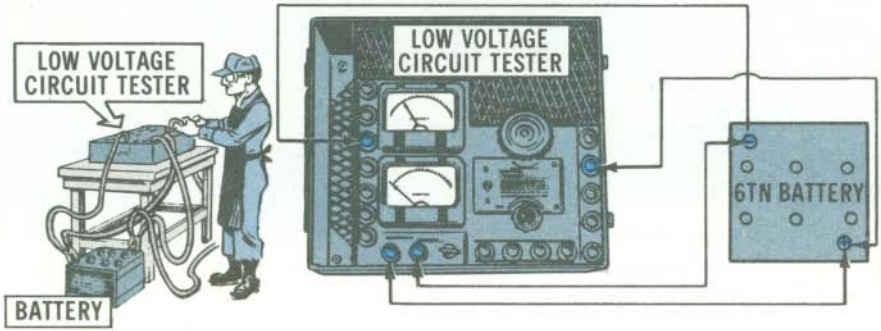
MAINTENANCE

Charging is the next step. This shows whether the electrolyte can be brought back to full strength. If you can't bring the battery up to full charge with 25 hours of charging, the battery's unserviceable.

LOAD TESTING

Finally, you test the battery to see if it can stand up under a load—working as hard as it would to crank an engine.

A fully charged 12-volt battery should show at least 12 volts output when it's tested with a multimeter. But this does not prove that the battery can hold up under a load. So you give the battery a load test. You do the test with a Low Voltage Circuit Tester (LVCT)—also known as Test Set, Generator and Voltage Regulator, Automotive.



See TM 9-4910-509-10 (Apr 75), Operator's Manual for Low Voltage Circuit Testers, page 28, Individual Battery Test. The same test is in TM 9-2320-218-20 (Sep 71) for the M151-series ¼-ton truck—page 2-36, Battery System Circuit, Test 4—and can be found in the electrical troubleshooting section of some other equipment TM's.

These TM's show the battery being load-tested in the vehicle, but the same test can be done on a battery in the shop.

If the battery fails the load test, the battery's unserviceable.

STORAGE OF WET-CHARGED

Store those batteries properly and they'll last a long time.

Never stack batteries on top of one another. That'll push in on the terminal post and damage the plates inside. You could even get enough weight to crack the caps or break the top out of the case.

Store batteries on a wood platform or on boards raised high enough to keep 'em out of the mud or off of the concrete.

If you have to store a lot of batteries, build a wood rack to put 'em on. TM 9-6140-200-14, para 3.2, tells how to build one.

Separate the batteries by type—6 TN, 2 HN, etc. Mark the date the battery was received, or charged, on the battery with chalk. That way it's easy to put the oldest battery in service first.

BATTERIES

TIPS TO THE BATTERY KEEPER:

- ★ KEEP 'EM DRY—UP OFF THE FLOOR OR GROUND.
- ★ KEEP 'EM COOL—BUT NOT WHERE IT'S FREEZING.
- ★ KEEP 'EM PROTECTED FROM BEING CRUSHED OR DAMAGED IN ANY OTHER WAY.
- ★ KEEP 'EM CHARGED UP!

All wet-charged batteries will slowly discharge during storage. They discharge faster when warm than when cold. To cut down on self-discharge, store the batteries in as cool a place as possible. Keep 'em away from heat ducts and radiators in the winter and shielded from direct sunlight in the summer.

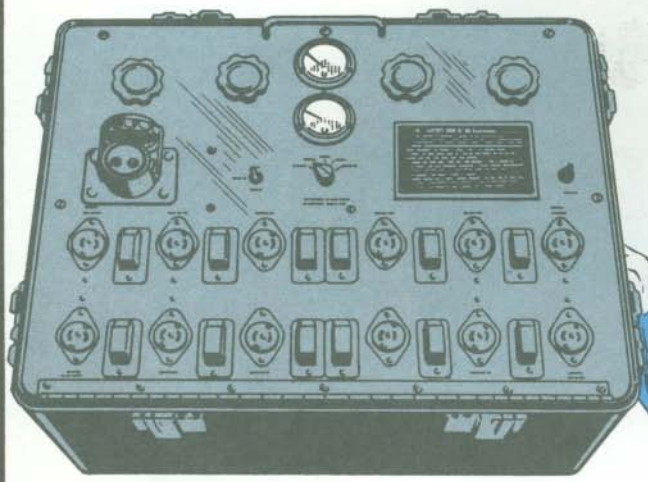
Keep an eye on those chalk-marked dates. Every 30 days check the specific gravity. If the specific gravity drops to 1.240, give the battery a booster charge. It doesn't matter whether they are going to be returned to storage, used or issued, charge 'em. Re-mark the new charging date on the battery with chalk. Then you can tell which are ready to use and which are ready for the 30 day check for specific gravity and possible recharging.

BATTERY

WITH DISTRIBUTION PANEL AND

A discharged battery—even partly-discharged—is a dying battery. It is self-destructing! A chemical action called "sulfation" is steadily destroying the guts of the battery. Soon, the battery can't be recharged. It's junk.

This can happen while the battery's installed in your equipment. It can happen while the battery's sitting on a shelf—unless the battery is a new



—NSN 6130-00-940-7866, in No. 1 and No. 2 Common Shop Equipment and No. 1 Supplemental
—TM 5-6130-301-12 (Oct 69)

The panel comes with:

A power cable for the generator connection.

12 inter-battery jumper cables.

12 charging cables used for charging individual batteries, 24-volt batteries and for 12-volt batteries in series.

CHARGING...

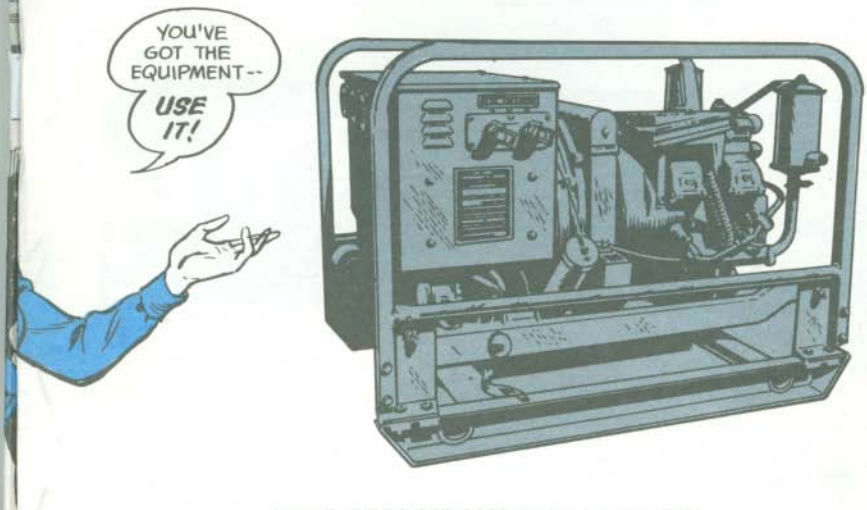
3-KW, 28-VOLT DC GENERATOR

charged-and-dry battery with no electrolyte in it.

But a fully-charged battery can sit idle for a long time without serious harm.

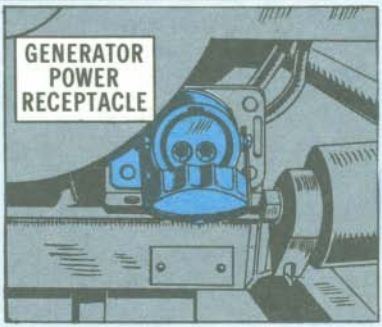
Keeping a battery up to full charge stretches its life. Checking the specific gravity of the electrolyte and recharging when needed pays off!

You do the charging with the distribution panel and generator.

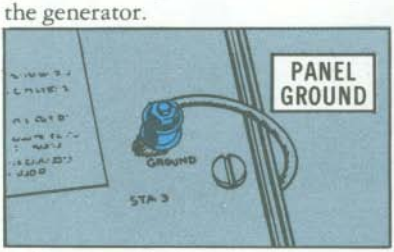


—NSN 6115-00-017-8239,authorized by TOE
—TM 5-6116-271-14 (Aug 76)
—TM 5-6116-271-24P (Oct 75)

The power cable connects the distribution panel to the generator—plugging into the receptacle on the panel and the receptacle on the generator.



You have to rig up your own ground wire—any heavy wire will do. The wire goes from the ground stud on the panel to a metal stake and to the frame of the generator.

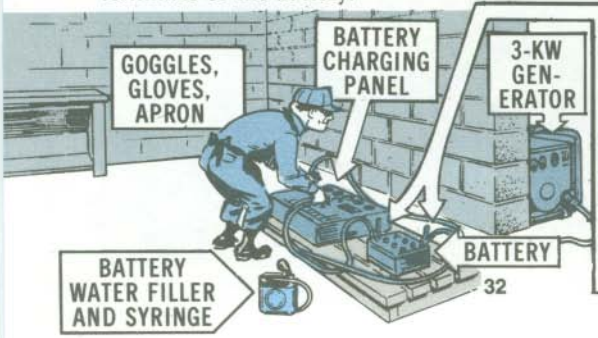


Good ventilation is important . . . both at the generator location and where you set up your batteries. The batteries give off hydrogen gas during charging, and a spark or flame could set it off. So, it's a good idea to locate the batteries as far from the generator as possible.

It should go without saying that you neither smoke nor permit an open flame near the batteries during charging.

Also, use safety goggles, a rubber apron and gloves . . . for your own protection.

To charge 24-volt batteries or single 12-volt batteries from the 2 12-volt station outlets, all you need is the charging cable. You plug the connector end of the cable into the station outlet and clip the ends to the positive and negative terminals of the battery.



CAREFUL! BE SURE TO CONNECT THE RED CABLE CLIP TO THE BATTERY POSITIVE POST. CONNECT THE BLACK CABLE TO THE NEGATIVE POST. IF YOU HOOK 'EM WRONG, YOU'LL WIND UP WITH A REVERSE CHARGED BATTERY—AND THIS CAN DAMAGE THE EQUIPMENT THE BATTERY'S INSTALLED IN.

You need a combination of charging cables and inter-battery cables for 6-volt batteries and for when you charge 2 12-volt batteries from a 24-volt station outlet. The panel TM gives you details on how to hook the inter-battery cables up.

PREPARING NEW BATTERY FOR CHARGING

Remove the protective seal in each battery cell. Tap it down into the cell—gently—with a small hammer and a wood dowel.

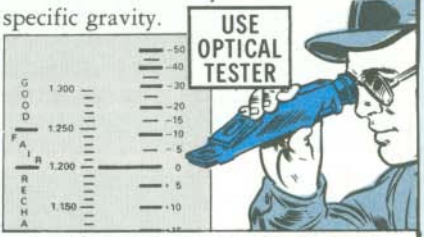
Fill each cell with electrolyte. The level should be ⅜-in above the plates. Wait 5-10 minutes. If the electrolyte is down, add more.

Let the battery cool for 1 hour. Now it's ready for charging.

PREPARING BATTERY FOR RECHARGING

A battery in for recharging must be clean—especially the terminal posts.

Check the electrolyte in all cells for specific gravity.



But if water has to be added to bring the electrolyte level up over the plates, you've got to charge the battery for about an hour to mix the new water into the electrolyte. Then you check the specific gravity.

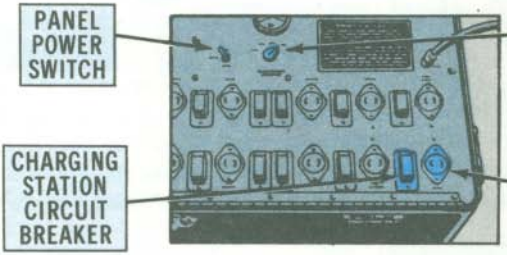
Group your rechargeable batteries by specific gravity. Put all those at 1.135 specific gravity and higher together. Same thing with those lower than 1.135. Then when you charge them, you'll stand a good chance of getting the same charge, at the same time for batteries of similiar specific gravity.

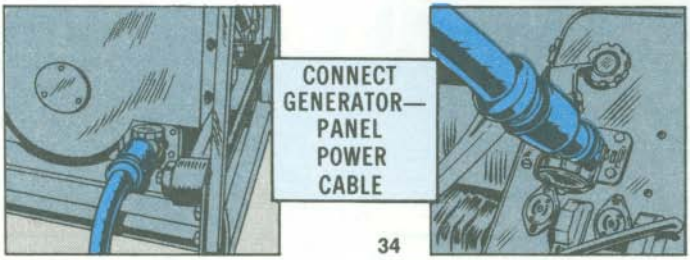
PUTTING IT ALL TOGETHER

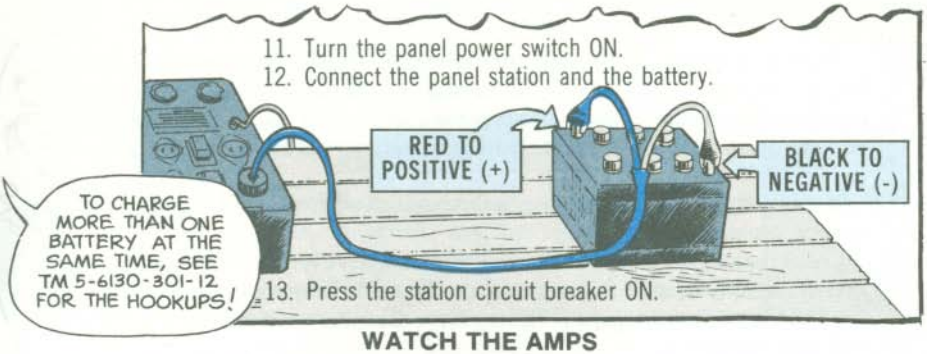
Now set up your charging outfit:

1. Ground the generator and distribution panel.
2. Flip the generator circuit breaker OFF.
3. Start the generator and operate it at 3,600 RPM.
4. Adjust the generator voltage control to show 28 volts on the voltmeter.
5. Flip the generator circuit breaker ON.
6. Recheck the voltage adjustment.

7. Turn the distribution panel power switch OFF.
8. Select charging station.
9. Press the charging station circuit breaker OFF.
10. Connect the generator and panel with the power cable.

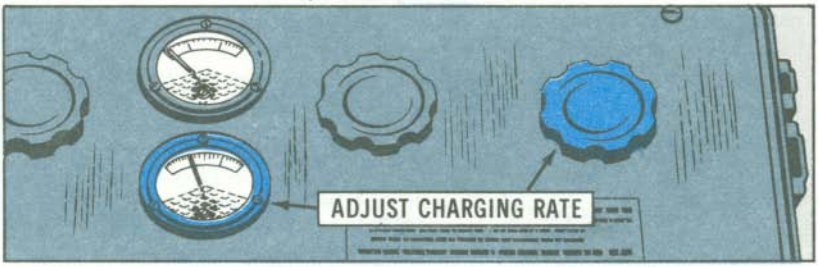





11. Turn the panel power switch ON.
12. Connect the panel station and the battery.
RED TO POSITIVE (+)
BLACK TO NEGATIVE (-)
TO CHARGE MORE THAN ONE BATTERY AT THE SAME TIME, SEE TM 5-6130-301-12 FOR THE HOOKUPS!
13. Press the station circuit breaker ON.

WATCH THE AMPS

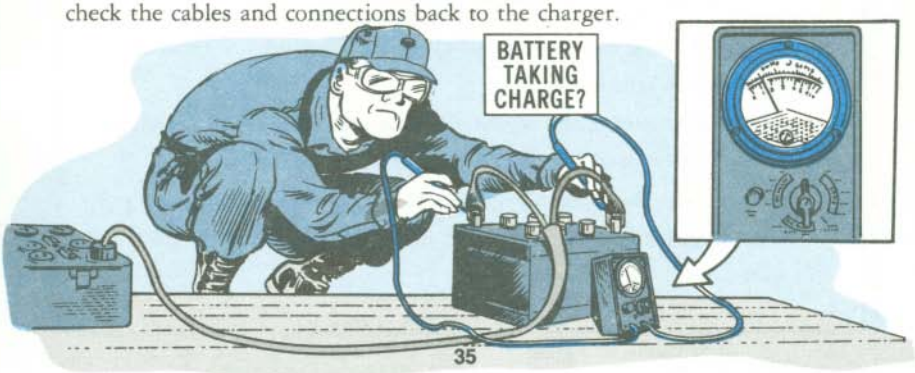
During charging, the battery should get a charge of 3-5 amps. Turn the charging rate control knob and adjust the amperage shown on the ammeter so it shows that the battery is getting the right charge.



If you've got 4 batteries hooked up, set the ammeter on 20 amps.

And you'll want to know if the battery is taking the charge. The charging system won't tell you that.

So, get your multimeter and set it for 50 VDC (100 VDC on some models). Check the battery. The meter should show about 15 volts—14½-16 is OK—with the charger connected. If you're not getting enough voltage to the battery, check the cables and connections back to the charger.



Overcharging Cooks Batteries to Death!

GOOD

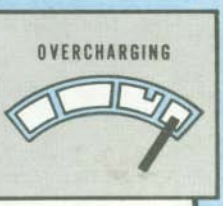
ENGINE RUNNING SMOOTHLY AT HIGH IDLE AND WARM.

ALL ELECTRICAL UNITS ON.

BAD

NEEDLE IN RIGHT RED SECTION SHOWS OVERCHARGING.

BATTERIES CAN'T TAKE IT!



GET YOUR MECHANIC TO CHECK OUT THE BATTERIES AND CHARGING SYSTEM:

DA PAM 750-33(DEC 76), CHARGING SYSTEM TROUBLESHOOTING (THE EASY WAY).